2004 GALVESTON BAY INVASIVE SPECIES RISK ASSESSMENT
INVASIVE SPECIES SUMMARY
Created by: Environmental Institute of Houston, University of Houston-Clear Lake
and the Houston Advanced Research Center

**Common Name: Mozambique tilapia**

**Latin Name:** *Oreochromis mossambicus* (syn *Chromis niloticus*, *Chromis mossambicus*, *Chromis niloticus*, *Chromis dumerili*, *Chromis vorax*, *Tilapia mossambica*, *Tilapia vorax*, *Chromis natalensis*, *Tilapia natalensis*, and *Sarotherodon mossambicus* (Trewevas, 1983)) http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html

**Category:** Aquatic Animal

**Place of Origin:** "This species naturally occurs along the eastern coast of Africa, in the lower Zambezi and its tributaries and eastward-flowing rivers and coastal lagoons southward to the Bushman's River, near Port Elizabeth, South Africa (Bruton and Bolt, 1975) (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Place of Introduction:** "Established or locally established in seven states including Arizona, California, Colorado, Florida, Hawaii, Idaho, and Texas. Formerly considered locally established but no longer extant in Georgia, Montana, and North Carolina. Reported from Alabama, Illinois, and New York (http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html)."

"The occurrence of *O. mossambicus* in the United States was reviewed by Courtenay and McCann (1981), Wieland et al. (1982), and Courtenay et al. (1986) (http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html)."

**Date of Introduction:** Stocked in Alabama in the 1950s and 1960s. But not reported recently. Other states report Mozambique tilapia found and/or stocked beginning in the 1960s or early 1970s (http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html).

"The history of this species introduction into the southwestern United States was reviewed by Hoover (1971), Courtenay and Robins (1989), Shapovalov et al. (1981), and Swift et al. (1993) (http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html)."

**Life History:** "Reproduction and Fecundity: According to Bruton and Bolt, 1975. The Mozambique tilapia is a mouth brooder. Males construct nests in areas of sparse to moderately dense vegetation. Females mouth brood the young. There have been a few reports of males mouth brooding young (Bruton and Bolt, 1975; Arthington and Milton, 1986). Maturation appears to usually occur between 150 and 160 mm in females and between 170 and 180 mm for males (Hodgkiss and Manson, 1978; Arthington and Milton, 1986). De Silva and Chandrasoma (1980) reported males maturing at 200-275 mm in Sri Lanka, with the percentage of mature males increasing dramatically above 275 mm.

Nests in Lake Sibaya, Africa were located at depths ranging from 41 cm to 8.5 m, and had diameters ranging from 20 cm to 142 cm. Eggs are fertilized within the nests and then carried off to deeper waters for maturation by the female. Incubation ranges from 20-22 days, and maturation of ova takes two weeks. Fry are released in shallow waters by females once they have reached a length of 9-10 mm. Release of fry appears to also be associated with cues relating to rainfall.

Although males are highly aggressive during the breeding season, under natural conditions most interactions appear to be ritualized, normally without serious injury resulting (Bruton and Bolt, 1975). Neil (1966), however, reported that although rare, fighting among males was very violent, with serious injury and even death occurring, among introduced tilapia in Hawaii. The white coloration on the head and red on the fins of breeding males is used in territorial and breeding displays (Trewevas, 1983).

Females may lay anywhere from 50-1780 eggs, varying according to the locality and the size of the female (Trewevas, 1983). Hodgkiss and Manson (1978) recorded a maximum of 1,754 eggs for the largest (25 cm) female caught from 38 examined in Plover Cove, Hong Kong. De Silva and Chandrosoma (1980) reported 360-1775 eggs per female in Sri Lanka. Arthington and Milton (1986) reported a mean of 2107 eggs for fish introduced in an artificial lake of Australia. Bruton and Bolt (1975) suggested that females may produce three or four broods per year in one breeding season in Lake Sibaya, Africa. Over tropical portions of its range, breeding occurs throughout the year (De Silva and Chandrasoma, 1980; Neil, 1966).

Very little information exists on the breeding of Mozambique tilapia in the Gulf states. However, they may compete for nesting areas with native fishes such as centrarchids, as has been reported for other cichlids (Courtney et al., 1974). Given the relatively cold water temperatures in the winter, their breeding is probably seasonal in the Gulf.

Growth: Males grow faster and become larger than females (Bruton and Allanson, 1974; Bruton and Boltt,1975). Like most cichlids, optimal growth occurs near 30°C (Price et al., 1985). However, growth rates vary depending on food availability and habitat quality (Bruton and Allanson, 1974; Bowen, 1979; Arthington and Milton, 1986). Over their natural range, several cases of stunted populations have been documented (Brunton and Allanson, 1974; Bowen, 1979). Bruton and Allanson (1974) believed this to be an adaptation to harsh environments. They reported average breeding size of Mozambique tilapia in food limited waters of Lake Sibaya, Africa, to be 100 mm in females and 120 mm in males, with the smallest breeding female found 68 mm and the smallest breeding

male 104 mm. A maximum size of approximately 260 mm for the population was reported. Bowen (1979) attributed the stunting observed in Lake Sibaya, to the poor protein content of the diet of Mozambique tilapia. On the other hand, high growth rates of fish reaching 350 mm in 8 months were reported in brackish waters conditions by Hickling in Trewevas (1983) (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Growth/Size:** "The Mozambique tilapia typically grows to about 380 mm (Trewevas, 1983). Coke (in Bruton and Allanson, 1974) reported a maximum size of 432 mm at Inyamiti pan, in Africa. In the Gulf, Mozambique tilapia typically grow to 140-220 mm SL with a maximum reported of 360 mm SL (Lee et al., 1980) (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Feeding Habits/Diet:** "In general, Mozambique tilapia are omnivorous, feeding on whatever is available, although they seem to show some preference for detritus and plant matter. Over their natural range, Mozambique tilapia appear to be primarily detritivorous, with diatoms playing an important role in their nutrition (Bowen, 1979; Trewevas, 1983). Bruton and Bolt (1975), however, reported differing diets among adults from different parts of Lake Sibaya. Feeding on filamentous algae, phytoplankton, zooplankton, vascular plant fragments, insects, crustaceans and small fish has also been reported (Neil, 1966; Bruton and Boltt, 1975; Trewevas, 1983, De Silva et al., 1984). In artificial lakes of Sri Lanka, where Mozambique tilapia support a substantial fishery, De Silva et al. (1984) found populations in different lakes to differ markedly in their diets. These ranged from almost exclusively detritivorous, to primarily herbivorous and even primarily carnivorous. Reports of Mozambique tilapia opportunistically feeding on other fish are common (Neil, 1966; Bruton and Boltt, 1975; Trewevas, 1983) (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Habitat:** "Depth: This species is usually restricted to relatively shallow waters (Bruton and Boltt, 1975). Over portions of its native range, juveniles, however, appear better adapted to inhabit deeper waters than adults (Caulton and Hill, 1973). Bowen and Allenson (1982) reported diel movement patterns of juveniles in Lake Sibaya, Africa, with juveniles moving from shallower waters to deeper waters in response to the movements of its chief predator, *Clarias gariepinnis*. Adult Mozambique tilapia move into deeper waters with the onset of colder temperatures, both over their natural range (Bruton and Boltt, 1975), and over colder portions of their non-native range (Arthington and Milton, 1986).

Salinity Tolerance: Over their native range Mozambique tilapia occur in freshwater and estuaries along the coast, tolerating a broad range of salinity's (Trewevas, 1983). However, they prefer estuarine waters (Dial and Wainright, 1983). Brock (1954), reported successful spawning in seawater under artificial conditions. Mozambique tilapia may be able to spawn in salinities of up to 30 ppt and survive in salinities of up to 40 ppt (Robins in Courtney et al., 1974). Knaggs in Dial and Wainright (1983) reported breeding in salinities of up to 34.5 ppt in California. In Florida this species is well established both in fresh water ponds and brackish water estuaries, whereas in Texas it appears more restricted to fresh waters. (Courtney et al., 1974; Hogg, 1976b, Shafland and Pestrak, 1982; Dial and Wainright, 1983).

Temperature Tolerance: *O. mossambicus* does not tolerate temperatures below 10°C, which appear to be a limiting factor over its native range (Trewevas, 1983) and in Gulf of Mexico drainages (Shafland and Pestrak, 1982). In Lake Sibaya, Africa, Bruton and Bolt (1975) reported seasonal movements to deeper waters during the cold season and to shallower waters in the warm season, with colder temperatures limiting the length of the breeding season. In tropical waters Mozambique tilapia breed throughout the year (Neil, 1966; De Silva and Chandrosoma, 1980). Shafland and Pestrak (1982) suggested a northern limit in Florida just south of Gainesville, for Mozambique tilapia based on a lower lethal temperature of 9.5°C estimated under laboratory conditions. However, they may venture further north through the use of thermal refuges, as has been the case with other cichlids such as the blue tilapia, *Oreochromis aureus* (Dial and Wainright, 1983, Hubbs et al., 1978). Lee et al. (1980) reported temperature tolerance down to 12 °C in fresh waters and 11° in brackish waters of Florida (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Attitude (aggressive, etc.):** "The extent of the impact of the Mozambique tilapia on native assemblages in Gulf drainages remains unclear. This species probably competes with native fishes such as centrarchids for nesting areas (Courtenay et al., 1974). Because of its aggressive breeding habits, where abundant, it may alter community structure (Neil, 1966; Bruton and Boltt, 1975). In addition, Mozambique tilapia may opportunistically feed on a number of different food items and hence have the potential to compete with a broad array of native taxa. Where common, such as in the estuarine waters of Florida, they may lower local biodiversity, through competition for trophic resources and direct predation. Hubbs et al. (1992) expressed special concern for native faunas of stenothermal springs in Bexar county, Texas (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Physical Description:** "Jaws of sexually mature males are enlarged, making their upper profile concave. Females and non breeding males are silver colored with 2-5 midlateral blotches, and occasionally a few dorsal blotches. Breeding males have a distinct black coloration with white on the lower parts of their heads and red on the margins of their dorsal and caudal fins. In addition, males have simple genital papilla with a shallow distal notch. Typically, there are 28-31 vertebrae with a mode of 30, 15-17 dorsal spines with a mode of 16, 26-29 total dorsal rays with a mode of mode 28, 3 anal spines, and 14-20 lower gill rakers with a mode of 17-18. The pharyngeal teeth are very fine. The caudal fin is not densely scaled (Trewevas, 1983) (http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html)."

**Management Recommendations / Control Strategies:** include references for existing site-specific strategies

**Government Permits and Regulations. http://www.isodata.com/aquaciti/govt/texas.htm Texas. Exotic Species Permit**

"Issuing Agency: Legal Counsel and Permits Branch
Resource Protection Division
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744
(512)389-4633

Statutory Reference: Sections 66.007 and 66.015, Texas Parks and Wildlife Code Section 134.020 Texas Agriculture Code

Regulatory Reference: Chapter 57.113, 57.114, 57.118, 57.129, Title 31, Texas Administrative Code

Activities Covered: Possession, propagation, transportation and sale of certain allowable exotic species that are considered harmful or potentially harmful to native species including: Blue Tilapia (Tilapia aurea) Mozambique Tilapia (Tilapia Mossambica) Mozambique X Aurea hybrids Silver Carp (Hypophthalmichthys molitrix) Black Carp (Mylopharyngodonpiceus) Bighead Carp (Aristichthys/Hypothalmicthys nobilis) Triploid Grass Carp (Ctenopharyn-godon idella) Pacific White Shrimp (Panaeus vannamei) - disease free certification required

Process: Meet all exotic species permit application requirements including but not limited to: 1) Possess valid Texas-fish farmers license; 2) Submit accurate-to-scale plat of the fish farm which indicates measures to prevent escape; 3) Allow inspection of facility; 4) After inspection permit can be issued within 1-2 months."

**References (includes journals, agency/university reports, and internet links):**


1. http://www.gsmfc.org/nis/nis/Oreochromis_mossambicus.html. Gulf of Mexico Program Non-Indigenous Species Summary.

2. http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html. USGS Nonindigenous Aquatic Species Profiles.

3. Courtenay, W. R., Jr., and J. A. McCann. 1981. Status and impact of exotic fish presently established in U.S. open waters (September 1, 1980; revised April 1981). In-House Report, National Fishery Research Laboratory, U.S. Fish and Wildlife Service, Gainesville, FL.

4. Wieland, W., W. L. Shelton, and J.S. Ramsey. 1982. Biological synopsis of the Mozambique tilapia (Tilapia mossambica). Final Report submitted to the National Fisheries Research Laboratory, U.S. Fish and Wildlife Service, Gainsville, Florida.

5. Courtenay, W. R., Jr., D. A. Hensley, J. N. Taylor, and J. A. McCann. 1986. Distribution of exotic fishes in North America. Pages 675-698 *in* C. H. Hocutt, and E. O. Wiley, editors. The zoogeography of North American freshwater fishes. John Wiley and Sons, New York, NY.

6. Hoover, F. G. 1971. Status report on *Tilapia mossambica* (Peters) in southern California. California Department of Fish and Game, Inland Fisheries Administrative Report 716. Unpublished mimeograph. 32 pp.

7. Shapovalov, L., A. J. Cordone, and W. A. Dill. 1981. A list of freshwater and anadromous fishes of California. California Fish and Game 67(1):4-38.

8. Swift, C. C., T. R. Haglund, M. Ruiz, and R. N. Fisher. 1993. The status and distribution of the freshwater fishes of southern California. Bulletin of the Southern California Academy of Science 92(3):101-167.

9. Courtenay, W. R., Jr., and C. R. Robins. 1989. Fish introductions: good management, mismanagment, or no management? CRC Critical Reviews in Aquatic Sciences 1(1):159-172.

10. For additional references, see the Annotated Bibliography.


**Available Mapping Information:**

1. Historical Distribution of *Oreochromis mossambicus* in Non-Native Range. Gulf of Mexico Program Non-Indigenous Species Summary. http://www.gsmfc.org/nis/nis/nnrange/Oreochromis_mossambicus_non-native_range.html

2. USGS Nonindigenous Aquatic Species Profiles. http://nas.er.usgs.gov/fishes/accounts/cichlida/or_mossa.html

3. Collection sites and reported localities are mapped for the United States (Courtenay and Hensley 1979a; Lee et al. 1980 et seq.), and for the states of Arizona (Minckley 1973; Grabowski et al. 1984) and Florida (Courtenay et al. 1974; Hogg 1976b; Courtenay and Hensley 1979a; Kushlan 1986; Loftus and Kushlan 1987).